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Contribution to the floristic knowledge of the head of the Po Valley (Piedmont, north Italy)

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Abstract

The annual field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society in 2014 was held in Piedmont (North Italy), at the head of the Po Valley. This valley, at whose head Monviso (3,841 m a.s.l.) is located, belongs to the Cottian Alps and from a floristic point of view very little was known about it. The inventory of the taxa of vascular plants collected during the field trip is reported. The field research led to the identification of 3570 *exsiccata*, kept in 9 public collections and 9 private collections. A total amount of 677 taxa belonging to 78 plant families were recorded. Six taxa resulted endemic to Italy and 3 exclusive to Piedmont, while only 9 alien species were detected; 6 taxa are new and 5 confirmed for the regional flora.

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Keywords

Cottian Alps, regional flora, new floristic records, vascular flora

Introduction

The contribution is part of the activities promoted by the working group for Floristics, Systematics and Evolution of the Italian Botanical Society, which since 2003 has given particular emphasis to territorial researches aimed at floristic censuses, jointly conducted by botanists from different regions. In particular, one of the goals of the working group is to increase knowledge about the vascular flora of poorly known areas. Only three expeditions were carried out in Central and Northern Italy (Peccenini et al. 2007, 2010, in Liguria; Peruzzi et al. 2011, in Tuscany).

In this paper we present the results of a field trip held in 2014 in Piedmont (North Italy), organized by Daniela Bouvet (University of Turin) and Annalaura Pistarino (Regional Museum of Natural Sciences of Turin) with the contribution of Adriano Soldano (Vercelli). The aim of the trip was to increase the floristic knowledge of the Po Valley, in the Piedmont's side of the Cottian Alps, that is poorly studied from the floristic and vegetational points of view, as evidenced by Bouvet et al. (2005), where the valley is considered as an "area with intermediate floristic knowledge".

Study area

The area covered by the excursion is located in Piedmont at the head of the Po River basin; from an administrative point of view it falls within the Cuneo province, in the municipalities of Oстана, Oncino and Crissolo and in a small part of Paesana (Suppl. material 1: 1).

The Po Valley is geographically located between the Pellice Valley to the north and the Varaita Valley to the south and southwest, and borders to the west with the Guil Valley along the Italian-French cross-border waterfront ridge. The valley runs from southeast to northwest from the plain to Paesana and irregularly east-west in the middle-upper part; it is over 30 kilometers long. The altitude ranges from 400 m a.s.l. at the bottom, at Revello-Martiniana Po, to 3,841 m a.s.l. at the top of Monviso, which surpasses by about 500 meters in altitude the surrounding peaks (Suppl. material 1: 1).

The Po Valley is one of the historic cross-border trade routes. It was an antique track, although less frequented than the Varaita Valley in the Middle Ages; it allowed the Marchesato of Saluzzo to connect with the Château Queyras (in the Guil Valley, currently in the Département Hautes-Alpes), through the road from Revello, Sanfront and Paesana, where it joined the one from Barge, ensuring connection with the Pinerolese area and the domains of Savoy. The ancient pedestrian pass of the Po Valley in the past has been the Colle delle Traversette (2,950 m a.s.l.) and the first alpine tunnel, the "Hole of the Viso" (2,882 m a.s.l.), a tunnel less than a hundred meters in length, was excavated in 1479-80 in order to allow trade with France.

The orography of the valley narrows upstream of Paesana, becoming steep and closed in the municipalities of Oстана, Oncino and Crissolo and widening in correspondence with the glacial plains of Pian della Regina and Pian del Re at the base of the Monviso mountain. The natural and social environment is characterized by a remarkable heterogeneity, with settlements organized in small historically important mountainous hamlets, located between the valley floor and the first mountain slopes. As in many western alpine valleys, the following phenomena occur:

- widespread abandonment and depopulation of the head of the valley, with sporadic small demographic events (eg Crissolo, Oстана, Oncino), and episodic congestion due to mostly summer tourism;

- abandonment of grassland-pastures marginal areas or impervious areas unsuitable for pasture, therefore with spontaneous re-naturalization through tree and shrub invasion and, at high altitude, through herbaceous and suffruticose alpine formations, with greater wilderness but with a lower patrimonial value;
- abandonment of anthropogenic forest (chestnuts) and progressive development of senescence and forest instability phases;
- interventions on watercourses, especially on the Po River, with the creation of artificial banks and weirs in the head of the valley, mostly with a loss of wilderness of the environment.

The Western Alps are characterized by a high degree of geological complexity (Compagnoni and Sandrone 1981). In particular the investigated area is located at the point of contact between two well-differentiated areas: at the head of the Po Valley near Ostana-Oncino, considering an imaginary north-south line from Villanova to Ostana, the Dora-Maira Massif to the east and the Piedmontese Zone of calcschists with ophiolites to the west are placed side by side (Suppl. material 1: 5).

The Dora-Maira Massif is characterized by metamorphic rocks, of both eruptive and sedimentary origin, involved in alpine orogenesis. The most common lithological types are gneiss and micaschists and, in subordinate quantities, quartzites, marbles and amphibolites.

The Piedmontese Zone consists of heterogeneous metamorphic rocks of sedimentary and eruptive origin, where three different sequences are distinguished by lithological composition: a predominantly triassic carbonate sequence, a jurassic carbonate-argillaceous sequence (calcschists) and a set of rocks linked to deep magmatic events (ophiolites). The landscape of the calcschistous areas, due to the poor resistance of these rocks to the atmospheric agents, is characterized by basically soft shapes, as opposed to the steep relief of green stones and limestone-dolomite walls.

The rocks of the Dora-Maira Massif and of the Piedmontese Zone emerge in the area with discontinuities: in fact, they are often covered with incoherent materials, resulting from their mechanical removal and their chemical alteration on the surface environment. In cartography they are generally referred to quaternary overlay, which includes morainic soils, alluvial and conoid deposits, debris and debris cones, eluvio-colluvial overlay.

From a climatic point of view, on the basis of the annual rainfall distribution, the head of the Po Valley is characterized by a continental pluviometric regime with the lowest rainfall being in winter. Pluviometric data for the Paesana municipality tend to a prealpine regime, with main rainfall peak in spring and secondary in autumn; data for the Crissolo municipality tend to a subalpine regime, with main rainfall peak in autumn and secondary in spring. Average annual temperature and precipitation values correspond to Thornthwaite as a humid climate for the municipality of Paesana (altitude 614 m a.s.l.) and as perhumid for the municipalities of Oncino (1,220 m a.s.l.), Ostana (1,250 m a.s.l.) and Crissolo (1,318 m a.s.l.) (Suppl. material 1: 2).

Part of the study area (e.g. the Alpetto Valley) is included in the "Parco naturale regionale del Monviso" (Monviso regional Park) and in the ZSC "Gruppo del Monviso e Bosco dell'Alevé" (IT1160058), in continuity with the Parc Naturel Régional du Queyras on the French side. In 2013 the Monviso has become a MaB Reserve of UNESCO.

Among the biotopes of particular interest from a botanical point of view, according to "Habitat Directive" 92/43/EEC, there are the Pian del Re peat bog (included in the Special Natural Reserve of the Parco del Monviso), which retains peculiar glacial wrecks (Priority habitats 7240 *Alpine pioneer formations of *Caricion bicoloris-atrofuscae* and 7230 Alkaline fens), and the maple-lime-ash forests in the Oncino Valley (Priority Habitat 9180 **Tilio-Acerion* forests of slopes, screes and ravines).

With regard to floristic studies conducted over the centuries in the Po Valley, there isn't an overall valley synthesis work: some punctual contributions have been published mostly for high-altitude flora or for findings of interesting species or studies for the conservation of protected areas. A summary of the results of surveys conducted over two centuries is currently being published (Bouvet et al. in prep.).

Material and Methods

During the four days of research (July 9-12, 2014), 34 participants to the field trip, accompanied by three forester of the Monviso regional Park (Suppl. material 1: 3) collected samples in 20 sites corresponding to biotopes considered significant for the head of the Po Valley. For each collecting site the reference number for the floristic list, collection date, toponyms with a short description, altitude, main habitats and cartographic coordinates (using UTM projection, ED50 geodetic system) are indicated (Suppl. material 1: 4). These collecting localities are related to litotypes of the substrates in Suppl. material 1: 5 and to a topographic map with a detail of 1:20,000 in Suppl. material 1: 6.

In analogy with the working method already experienced in previous trips, the identification of *exsiccata* was carried out firstly individually by the collectors; then the most critical samples were revised by botanists present at a two-day meeting held on 23 and 24 February 2015 at the Department of Life Sciences and Systems Biology of the University of Turin. Specimens with no satisfactory identification yet were re-examined by some participants.

The floristic list was produced with the contribution of almost all participants to the field trip; some critical genera required the support of specialists, to whom the samples were sent for review: Ardenghi N.M.G. (*Festuca*, *Schedonorus*), Buccheri M., Casolo V. and Martini F. (*Achillea*), Cecchi L. (*Pulmonaria*), Domina G. (*Orobanche*), Dotti L. and Isaja A. (*Herminium*, *Nigritella*), Festi F. and Fröhner S.E. (*Alchemilla*), Gallo L. (*Hylotelephium*, *Sedum*, *Sempervivum*), Gottschlich G. (*Hieracium*, *Pilosella*), Marchetti D. (*Asplenium*, *Cystopteris*, *Dryopteris*), Martignoni M. (*Euphrasia*), Martinetto E. (*Cyperaceae*), Paiero P. (*Salix*), Polidori J.-L. (*Gentiana*), Scoppola A. (*Viola*), Selvaggi A. (*Juncus*, *Luzula*), Vogt R. (*Leucanthemum*) and Zaccara P. (*Pinguicula*).

Each systematic unit in the list is supported by at least one herbarium sample stored in either a public or private collection (Suppl. material 1: 7). Nomenclature and taxa delimitation followed the updated version of the Checklist of Italian Flora (Bartolucci et al. 2018, Galasso et al. in press), except for varieties and hybrids (not considered in the above-mentioned Checklist).

In the floristic list (Suppl. material 1: 9) the systematic order and taxonomic circumscription of the families follow the classification proposed by PPG I (2016) for ferns and fern allies, by Christenhusz et al. (2011) for gymnosperms and by APG IV (2016) for angiosperms, with the exception of Dipsacales (Reveal 2011), Caryophyllales (Hernández-Ledesma et al. 2015) and Boraginales (Luebert et al. 2016). Taxa are ordered alphabetically within each family. For each unit, synonyms are indicated in square brackets only in the case of changes that have occurred since the former version of the checklist of the Italian vascular flora (Conti et al. 2005, 2007). The reference number of the collecting site (Suppl. material 1: 4) and, in brackets, the *herbaria* collections in which the samples are kept, are reported below; if belonging to public collections they are indicated with their acronym according to Thiers (2017), if part of a private collections with a code indicated in Suppl. material 1: 7.1.

The letter “E” preceding the scientific name indicates an endemic taxon for Italy (following Bartolucci et al. 2018); the letter “e” refers to few “exclusive” taxa, i.e. taxa that within Italy are only present in Piedmont, but are also present in neighbouring countries (France and/or Switzerland) (according to Bartolucci et al. 2018 and Aeschimann et al. 2004). The letter “A” indicates an alien taxon; it is followed by the regional status: “NAT” for a naturalized species, “INV” for an invasive species (according to Bartolucci et al. 2018 and Galasso et al. in press). The floristic novelties for the regional flora, as referred to by Bartolucci et al. (2018) are marked with asterisks (** = new taxon, * = confirmed taxon, previously “Doubtful” or “Not Confirmed”). For some units that were particularly critical, a systematic, taxonomic and/or nomenclatural note has been included.

Results

During the field trip almost 3700 samples of vascular plants were collected. The specimens identified at the species level are 3570.

Among these, 597 specimens were collected in the first half-day of the excursion, 1709 in the second day, 957 in the third day and 307 in the fourth half-day. The site with the largest number of samples collected is by far n. 3 (n=446) (see the number of *exsiccata* for each site in the Suppl. Material 1: 8). The specimens identified and included in the floristic list were 3570, belonging to 677 taxa and 78 plant families (see Suppl. material 1: 9), including three varieties (*Thymus pulegioides* L. var. *pulegioides*, *Thymus pulegioides* L. var. *vestitus* [Lange] Jalas, *Laserpitium gallicum* L. subsp. *gallicum* var. *angustifolium* [L.] Lange) and two hybrids (*Carex lepidocarpa* Tausch \times *Carex demissa* Hornem., *Hypericum* \times *desetangii* Lamotte).

Six taxa are considered endemic to Italy (indicated with “E” in Suppl. material 1: 9), following Bartolucci et al. (2018):

Sedum alsinifolium All.

Alchemilla vaccariana Buser

Dianthus furcatus Balb. subsp. *lereschii* (Burnat) Pignatti

Pulmonaria vallarsae A.Kern. subsp. *apennina* (Cristof. & Puppi) L.Cecchi & Selvi

Melampyrum italicum (Beauverd) Soó

Campanula elatines L.

Amongst these, according to Bartolucci et al. (2018) two species are only present in Piedmont (*Campanula elatines* L. and *Sedum alsinifolium* All.), one only in Piedmont and the Aosta valley (*Alchemilla vaccariana* Buser) and one only in Piedmont and the Aosta valley and doubtfully in Liguria (*Dianthus furcatus* Balb. subsp. *lereschii* [Burnat] Pignatti).

Three taxa are exclusive to Piedmont (i.e. present in no other region of Italy, but in neighbouring nations), according to Bartolucci et al. 2018 and Aeschimann et al. 2004, and indicated with “e” in Suppl. material 1: 9):

Pulsatilla alpina (L.) Delarbre subsp. *cottianaea* (Beauverd) D.M.Moser (endemic of the Western Alps, present in Piedmont and France)

Gentiana rostanii Reut. ex Verl. (endemic of the Western Alps, present in Piedmont and France)

Hieracium piliferum Hoppe subsp. *subnivale* (Gren. & Godr.) Zahn (endemic of south-west Europe, present in Piedmont and France).

Only nine alien species were found (according to Bartolucci et al. 2018 and Galasso et al. in press):

- four of them are considered invasive in Piedmont (indicated with “A INV” in Suppl. material 1: 9):

Juncus tenuis Willd.

Robinia pseudacacia L.

Erigeron annuus (L.) Desf.

Galinsoga quadriradiata Ruiz & Pav.

- five are considered naturalized (indicated with “A NAT” in Suppl. material 1: 9):

Papaver argemone L. subsp. *argemone*

Oxalis stricta L.

Digitalis purpurea L. (spontaneous in Calabria and Sardinia)

Veronica persica Poir.

Matricaria discoidea DC.

Six taxa are floristic novelties for the regional flora of Piedmont, referring to Bartolucci et al. (2018) (indicated with “**” in Suppl. material 1: 9); in the list below “o” indicates taxon that was not included in Conti et al. 2005 and 2007 but introduced in the Italian flora in Bartolucci et al. 2018):

o *Melica transsilvanica* Schur subsp. *klokovii* Tzvelev

Saxifraga cuneifolia L. subsp. *robusta* D.A.Webb

Alchemilla transiens (Buser) Buser

Salix waldsteiniana Willd.

Tilia platyphyllos Scop. subsp. *cordifolia* (Besser) C.K.Schneid.
Taraxacum panalpinum Soest

One more species, *Alchemilla chirophylla* Buser, could be a new species for Piedmont, but the only specimen collected doesn't allow a certain identification, therefore the presence of this taxa has to be further investigated.

Three taxa were considered "doubtful" in Piedmont in Bartolucci et al. (2018) and are thus confirmed (indicated with * in Suppl. Material 1: 9); "o" indicates taxon that was not included in Conti et al. (2005, 2007) but introduced in the Italian flora in Bartolucci et al. 2018:

o *Helictochloa praeusta* (Rchb.) Romero Zarco subsp. *pseudoviolacea* (Dalla Torre) H.Scholz
Cuscuta planiflora Ten.
Picris hieracioides L. subsp. *umbellata* (Schränk) Ces.

The finding of these two species, for which the specimens collected in the Po valley are the first ones for more than fifty years, confirms the presence of the entity in Piedmont (indicated with "*" in Suppl. material 1: 9):

Centaurea scabiosa L. subsp. *alpestris* (Hegetschw.) Nyman
Leucanthemum ircutianum DC. s.l.

In the list of taxa there is a significant number of plants included in Red Lists (the category of risk is indicated in brackets):

- seven species are included in the Red List of Piedmont (Conti et al. 1997):

Carex fimbriata Schkuhr (Lower risk, also included in the Italian Red List)
Aquilegia alpina L. (Lower risk)
Sedum alsinifolium All. (Lower risk)
Malva moschata L. (Lower risk)
Nocca sylvia (Gaudin) F.K.Mey. (Lower risk, also included in the Italian Red List)
Drosera rotundifolia L. (Vulnerable)
Cerastium lineare All. (Lower risk, also included in the Italian Red List)

- eight taxa are included in the IUCN Red List of the Italian Flora (Rossi et al. 2013):

Huperzia selago (L.) Bernh. ex Schrank & Mart. subsp. *selago* (Least concern)
Lycopodium clavatum L. (Least concern)
Selaginella helvetica (L.) Spring (Least concern)
Selaginella selaginoides (L.) P.Beauv. ex Schrank & Mart. (Least concern)
Herminium monorchis (L.) R.Br. (Endangered)
Aquilegia alpina L. (Least concern)
Gentiana lutea L. subsp. *lutea* (Near threatened)
Arnica montana L. subsp. *montana* (Least concern).

A number of species have not been identified at the most detailed level: one taxa is identified at the section level (*Taraxacum* sect. *alpina* G.E. Haglund), nineteen species are identified *sensu lato* (*Viola calcarata* L., *Bupthalmum salicifolium* L., *Hieracium bifidum* Kit. ex Hornem., *H. dasytrichum* Arv.-Touv., *H. dentatum* Hoppe, *H. glaucinum* Jord., *H. lachenalii* Suter, *H. murorum* L., *H. obscuratum* Murr., *H. pilosum* Schleich. ex Froel., *H. ramosissimum* Schleich. ex Hegetschw., *H. scorzonifolium* Vill., *H. tenuiflorum* Arv.-Touv., *H. valdepilosum* Vill., *H. villosum* Jacq., *Leucanthemum ircutianum* DC., *Pilosella lactucella* [Wallr.] P.D.Sell & C.West, *P. piloselloides* [Vill.] Soják, *Scabiosa columbaria* L.), nine taxa have not been identified with certainty and indicated with "cfr." (*Festuca plonkiae* Foggi & Signorini, *Alchemilla chirophylla* Buser, *A. incisa* Buser, *Urtica dioica* L. subsp. *pubescens* [Ledeb.] Domin, *Hypericum* × *desetangsii* Lamotte, *Erysimum jugicola* Jord., *Pinguicula reichenbachiana* Schindl., *Leucanthemum coronopifolium* Vill. subsp. *ceratophylloides* [All.] Vogt & Greuter, *L. heterophyllum* [Willd.] DC.). This occurs for critical genera and species; in many cases it is due to the lack of parts of the plant necessary for identification.

Discussion

The 677 taxa found in the study area represent almost 17% of the Piedmont's flora (n=4015 taxa, according to Bartolucci et al. 2018 and Galasso et al. in press), over an area that represents only 0.4% of the regional area (the Crissolo, Oncino and Ostana municipalities occupy a surface area of 113 km², out of the 25,387 km² of the regional total).

Endemic taxa (n=6) amount to almost 0.9% of the taxa observed and to 3.8% of the endemic species present in Piedmont (n=158, according to Bartolucci et al. 2018).

The percentage of alien species is very low (1.3%) compared to the regional average (10.5%, according to Blasi et al. 2010), probably due to the altitude of the collecting sites, always above 900 m a.s.l. and to the relative low rate of anthropization of the habitats explored. This low percentage reveals that the area includes environments with a high degree of wilderness.

Overall, there are 6 new features for Piedmont's flora and 5 confirmations of doubtful or not confirmed taxa.

The high number of detected species, although in a few days of collection and in a small number of sites, suggests that the flora diversity of the studied area is significant and deserves further research. In particular the Alpetto Valley and the surroundings of Ostana were unknown from a floristic point of view. The collected data also contribute to the drafting of the naturalistic plan of the "Parco del Monviso" and provide useful data for monitoring habitats and species of European interest (as required by Habitat Directive 92/43/EEC).

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Supplementary material 1

Supplementary data

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Data type: Word .doc file

Explanation note:

- 1.1. Area where the annual field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society took place, from 9 to 12 July 2014. For detailed topographic map of each site see Suppl. material 1: 6.
- 1.2. Monviso and the head of Po Valley.
- 2.1. Temperature and rainfall data for the weather station of Paesana (1,265 m a.s.l.) in the period 1993-2017.
- 2.2. Temperature and rainfall data for the weather station of Crissolo (1,342 m a.s.l.) in the period 2012-2017.
- 2.3. Snowfall data for the weather stations of Paesana (1,265 m a.s.l.) and Pian Giasset (2,150 m a.s.l.) in the period 2002-2017.
3. The 34 participants to the field trip of the working group for Floristics, Systematics and Evolution of the Italian Botanical Society from 9 to 12 July 2014.
4. List of collecting sites, with reference number, date of collection, placename with short description, altitude, main habitats and cartographic coordinates (expressed using UTM projection, ED50 geodetic system, zone 32T). For detailed topographic map of each site see Suppl. material 1: 6.
5. Collection sites displayed on the Geological map of Italy (scale 1:100,000). For detailed code of each site see Suppl. material 1: 4.
6. Topographic maps (scale 1:20,000) with collecting sites. For detailed code of each site see Suppl. material 1: 4.
- 7.1 Public *herbaria* and private collections in which the *exsiccata* collected are kept. Acronyms of public collections refer to Thiers (2017).
- 7.2 Number of *exsiccata* kept in the different collections.
8. Number of *exsiccata* collected for each site. For detailed topographic map of each site see Suppl. material 1: 6.
9. Floristic list of taxa observed at the head of the Po Valley (Piedmont, province of Cuneo) with reference number of collecting site and *herbaria* collections (in brackets). For detailed code of each site see Suppl. material 1: 4, 7.1.

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